Geologic Resource Evaluation Scoping Summary
Saguaro National Park, Arizona

Geologic Resources Division
National Park Service
US Department of the Interior

The Geologic Resource Evaluation (GRE) Program provides each of 270 identified natural area National Park Service units with a geologic scoping meeting, a digital geologic map, and a geologic resource evaluation report. Geologic scoping meetings generate an evaluation of the adequacy of existing geologic maps for resource management, provide an opportunity for discussion of park-specific geologic management issues and, if possible, include a site visit with local experts. The purpose of these meetings is to identify geologic mapping coverage and needs, distinctive geologic processes and features, resource management issues, and potential monitoring and research needs. Outcomes of this scoping process are a scoping summary (this report), a digital geologic map, and a geologic resource evaluation report.

The National Park Service held a GRE scoping meeting for Saguaro National Park (SAGU) on April 4, 2006, at the NPS Saguaro National Park Fire Offices. Stephanie O'Meara (CSU) facilitated the discussion of map coverage and Sid Covington (NPS GRD) led the discussion regarding geologic processes and features at the park. Jon Spencer (AZGS) gave a presentation on the geologic history of the area and led a field trip in the afternoon to the Catalina Fault exposure. Phil Pearthree (AZGS) gave a presentation on surficial geology as it applies to the National Parks. Participants at the meeting included NPS staff from the park, Geologic Resources Division, and Sonoran Desert Network and cooperators from the Arizona Geological Survey (AZGS), Arizona State Parks, the University of Arizona, and Colorado State University (CSU) (see table 2). This scoping summary highlights the GRE scoping meeting for Saguaro National Park including the geologic setting, the plan for providing a digital geologic map, a prioritized list of geologic resource management issues, a description of significant geologic features and processes, lists of recommendations and action items, and a record of meeting participants.

Park and Geologic Setting

Saguaro National Park consists of two districts: (1) the Tucson Mountain District (SAGU West), west of Tucson, and (2) the larger Rincon Mountain District (SAGU East), east of Tucson. Saguaro National Park includes 91,439.71 acres of which 87,526.07 are federal and 3,913.64 are nonfederal acres. The park was established as a National Monument on March 1, 1933, and transferred from the U.S. Department of Agriculture, Forest Service to the National Park Service August 10, 1933. On October 20, 1976, 70,905 acres of the park were designated a wilderness area. Saguaro was redesignated a National Park on October 14, 1994. The national park was established to protect its namesake, the giant saguaro cactus, which can grow over 50 feet (15 m) tall and can weight over 5 tons.

Saguaro NP lies within the Mexican Highland section of the Basin-and-Range Province although the Rincon Mountain District and the Tucson Mountain District contain markedly different geology. The Rincon Mountain District displays a three-humped metamorphic core complex while the Tucson Mountain District consists of fault-bounded structures. The Rincon Mountains (including the Santa Catalina and Tortolita Mountains) are considered to be the "showpiece" of metamorphic core complexes (Davis, 1987). Between the two districts, Tucson occupies the relatively flat-floored structural basin between the two mountain ranges.

Geologic Mapping for Saguaro National Park

During the scoping meeting Stephanie O'Meara (CSU) showed some of the main features of the GRE Programs digital geologic maps, which reproduce all aspects of paper maps, including notes, legend, and cross sections, with the added benefit of GIS compatibility. The NPS GRE Geology-GIS Geodatabase Data Model incorporates the standards of digital map creation set for the GRE Program. Staff members digitize maps or convert digital data to the GRE digital geologic map model using ESRI ArcMap software. Final digital geologic map products include data in geodatabase, shapefile, and coverage format, layer files, FGDC-compliant metadata, and a Windows HelpFile that captures ancillary map data.

When possible, the GRE program provides large scale (1:24,000) digital geologic map coverage for each park's area of interest, which is often composed of the 7.5-minute quadrangles that contain park lands. Maps of this scale (and larger) are useful to resource management because they capture most geologic features of interest and are positionally accurate within 40 feet. The process of selecting maps for management use begins with the identification of existing geologic maps and mapping needs in vicinity of the park. Scoping session participants then select appropriate source maps for the digital geologic data to be derived by GRE staff.

Map coverage for Saguaro NP consists of 10 quadrangles of interest mapped at a 1:24,000 scale (figure 1). In the Tucson Mountain District, these quadrangles are: Jaynes, Cat Mountain, Brown Mountain, and Avra quadrangles. In the Rincon Mountain District, the quadrangles of interest are Happy Valley, Galleta Flat West, Rincon Peak, Vail, Tanque Verde Peak, and Mica Mountain. These quadrangles are located on the Tucson and Silver Bell Mountain 30' x 60' sheets.

Table 1 lists the source maps chosen for Saguaro National Park. At the request of Saguaro staff, GRE staff digitized GMAPs 1003, 1083, and 1084. Comparing these GMAPs, Jon Spencer (AZGS) felt that the only useful map was the following Lipman map (GMAP 1003):

- Lipman, Peter W. 1993. Geologic map of the Tucson Mountain Caldera, Southern Arizona. U.S. Geological Survey, I-2205. 1:24,000 scale.

According to Jon Spencer, the Lipman map is a "wonderful map" and a "state-of-the-art" map. Lipman was in the forefront of understanding calderas, and his map illustrates his understanding of the processes associated with the Tucson caldera (Jon Spencer).

USGS and AZGS geologists at the meeting suggested that several problems exist with the Drewes maps (GMAPs 1083 and 1084), principally with regard to structural interpretation and faulting contacts. Drewes mapped quickly and his 1:48,000 scale maps cover a lot of ground (Jon Spencer). Drewes did not take the time to walk out contacts so he makes many mistakes regarding whether these contacts are fault related or lithologic. Although colorful, the maps were made hastily, and their accuracy should be questioned (Jon Spencer).

Table 1. GRE Mapping Plan for Saguaro National Park

Covered Quadrangles	GMAP[1]	Citation	Scale	Format acquired by GRE	Assessment	GRE Action
Saguaro West quads.	1003	Lipman, Peter W., 1993, Geologic map of the Tucson Mountain Caldera, Southern Arizona, U.S. Geological Survey, I-2205, scale 1:24,000.	1: 24,000	paper	Bedrock map for SAGU West.	Conversion of digital data to geodatabase data model format; will integrate into either FY06 or FY07 projects.
Rincon Valley, Mica Mountain, Tanque Verde Peak	1083	Drewes, Harald, 1977, Geologic map and sections of the Rincon Valley quadrangle, Pima County, Arizona, U.S. Geological Survey Miscellaneous Investigations Series Map I-997, scale 1:48,000.	1: 48,000	paper	"Best available map" for most of the Mica Mountain & Tanque Verde Peak quads; hastily made map; question accuracy	Conversion of digital data to geodatabase data model format; will integrate into either FY06 or FY07 projects.
Happy Valley	1084	.Drewes, Harald, 1974, Geologic map and sections of the Happy Valley quadrangle, Cochise County, Arizona, U.S. Geological Survey, Miscellaneous Investigations Series Map I-832, 1:48000 scale	1: 48,000	paper	Hastily made map; question accuracy.	Conversion of digital data to geodatabase data model format; will integrate into either FY06 or FY07 projects.
northern Vail, southern Tanque Verde Peak, northwest Rincon Peak, southwest Mica Mtn.	7465	Richard, S.M., Spencer, J.E., Youberg, A., Ferguson, C.A., 2005, Geologic Map of the Rincon Valley Area, Pima County, Arizona. Arizona Geological Survey, DGM-44, 1:24000 scale	1: 24,000	digital	Northern Vail, southern Tanque Verde Peak, northwest Rincon Peak, & southwest Mica Mountain quads.	Conversion of digital data to geodatabase data model format; will integrate into either FY06 or FY07 projects.
Galleta Flat West,	7468	Skotnicki, S.J., and Siddoway, C.H., 2001, Compilation Geologic map of the Galleta Flat West 7.5' Quadrangle, Pima and Cochise Counties, Arizona, Arizona Geological Survey Digital Geologic Map 8 (DGM-8), 1:24,000 scale, layout with 18 p. text	1: 24,000	digital	Galleta Flat West quad.	Conversion of digital data to geodatabase data model format; will integrate into either FY06 or FY07 projects.
southern Vail,	7495	Richard, S.M., Spencer, J.E., Ferguson, C.A., Youberg, A., 2001, Geologic map of southern part of the Vail 7 ½' Quadrangle, eastern Pima County, Arizona: Arizona Geological Survey Digital Geologic Map 12 (DGM-12), 1:24,000 scale, layout with 29 p. text (revised July, 2002)	1: 24,000	digital	southern Vail quadrangle.	Conversion of digital data to geodatabase data model format; will integrate into either FY06 or FY07 projects.
The Narrows, southern Rincon Peak	7496	Spencer, J.E., Ferguson, C.A., Richard, S.M., Orr, T.R., Pearthree, P.A., Gilbert, W.G., and Krantz, R.W., 2001, Geologic map of The Narrows 7 ½' Quadrangle and the southern part of the Rincon Peak 7 ½' Quadrangle, eastern Pima County, Arizona, Arizona Geological Survey Digital Geologic Map 10 (DGM-10), v. 1.1, 1:24,000 scale, layout with 32 p. text (revised May, 2002)	1: 24,000	digital	southern Rincon Peak quadrangle.	Conversion of digital data to geodatabase data model format; will integrate into either FY06 or FY07 projects.

Saguaro West quads.	No GMAP ID	Pearthree, P.A., Klawon, J.E., Dickinson, W.R., Biggs, T.H., and Orr, T.R., 1999, Digital surficial geologic map and geographic database of the northern Tucson basin and Tucson Mountains, Pima County, Arizona, Arizona Geological Survey Digital Information Series DI-17, 1 CD-ROM		digital	surficial map for the west SAGU unit.	Conversion of digital data to geodatabase data model format; will integrate into either FY06 or FY07 projects.
Saguaro East quads. – Happy Valley area	No GMAP ID	Dickinson, W.R., 1998, Geologic Relations of Martinez Ranch Fault and Happy Valley Neogene Basin, East Flank of Rincon Mountains, Pima County, Arizona, Arizona Geological Survey, CM-98-B, 1:24,000 scale layout with text and sheet, 16 p.	1: 24,000	paper	Happy Valley area.	Digitization to geodatabase data model format; will integrate into either FY06 or FY07 projects.

[1]GMAP numbers are unique identification codes used in the GRE database.

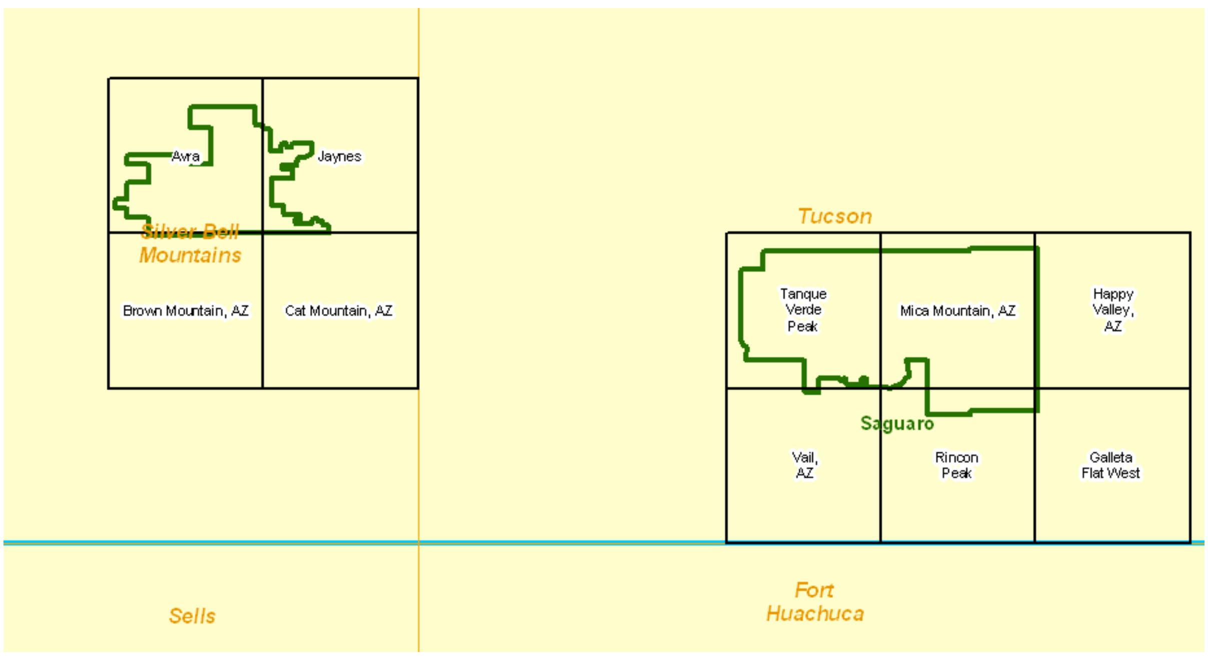

Figure 1. Quadrangles of Interest for Saguaro National Park, Arizona. The 7.5-minute quadrangles (scale 1:24,000) are labeled in black; names in yellow indicate 30-minute by 60-minute quadrangles (scale 1:100,000). Names in blue indicate 1-degree by 2-degree sheets (scale 1:250,000). Green outline indicates the boundary of the monument.

The Rincon Mountain District, an area east of the Catalina Fault, consists of gneisses and granites and the contacts between rock units are difficult to map. A great deal of time could be spent mapping in this area, but there would still be various opinions regarding the geology. It's probably not worth re-mapping the area east of the Catalina Fault (Jon Spencer).

West and south of the Catalina Fault, however, the units have names and are clearly identifiable. New mapping is needed in this area (Jon Spencer). The desired area only extends from the fire building to NPS headquarters.

The Catalina Fault dips gently to the southeast. Part of the area has been mapped by the AZGS, and problems have been found with Drewes' map. Jon Spencer suggested that the Loop Drive needed to be re-mapped, also.

Students of Professor George Davis, University of Arizona, visited the area in the 1970s to do detailed studies for research, but they didn't do extensive mapping (Jon Spencer). Likewise, students from the University of Texas have studied, but not mapped, the area.

The following map in Table 1 covers the Rincon Valley area and since the meeting, a digital copy of the map has been acquired by GRE:

- Richard, S.M., Spencer, J.E., Youberg, A., Ferguson, C.A. 2005. Geologic Map of the Rincon Valley Area, Pima County, Arizona. Arizona Geological Survey, DGM-44, 1:24,000 scale.

In discussing the mapping needs for SAGU West and SAGU East, a question was raised as to whether or not there was adequate coverage for the West unit. Adequate coverage includes any quadrangles of interest that might border the park, but not include the park. Meg Weesner (NPS SAGU) pointed out that very little of the park is in the Brown Mountain quadrangle, and none of the park is in the Cat Mountain quadrangle, but these are areas of interest to the park.

Phil Pearthree (AZGS) said that surficial map coverage is adequate for the West district and mapping has been done in the areas of interest. He commented that most of the maps in Table 1 are bedrock maps and that the surficial maps that the AZGS has done aren't listed on the table.

Meg Weesner asked for clarification regarding surficial versus bedrock geologic maps. Phil Pearthree explained that surficial maps define the location of young, unconsolidated deposits. In Saguaro NP, these deposits are mostly stream and alluvial deposits. The map coverage known to GRD and presented at the meeting was a compilation of both. Stephanie O'Meara explained that the GIS products that are a part of the GRE could produce separate layers for both surficial and bedrock geology, a capability that is missing from hard copies of geologic maps. The Saguaro maps have both surficial and bedrock layers. In addition, each layer of the GIS map has more detail as a data layer.

Surficial geology of Saguaro NP impacts water distribution, soils, particle size, and rock type which all affect the vegetation assemblages in the park (Phil Pearthree). The surficial geology can also be used to assess potential archaeological features and sites. Hazards such as flooding, landslides, debris flows (especially after fires), soil problems, and water supply also are tied to the surficial geology. Habitat loss results from fire (i.e., Leopard Frog habitat) and more information on the surficial geology might be helpful in identifying potential problem areas in the future (Don Swann, NPS SAGU).

In SAGU West, the piedmonts are dramatically different with regard to rock type and sediment. The surficial geology is important to identify areas of tributary incision and areas of potential sheet flooding (Phil Pearthree).

Bob Casavant (AZ State Parks) wanted to know if GRD would digitize a more detailed map if it were available. Don Swann also was interested in this as he had found a detailed fault map in the files and noted that there were two or three other studies that had been done by students and were in the files, as well. The park is in the process of collecting an inventory of all information that future managers might need and the question arose: is there a way to put in a layer to access this database?

The GIS maps can capture all data points so, if desired, the finished GIS map could capture the hundreds of data points on the fault map depending on the purpose of the digital map to a baseline inventory for the resource manager (Stephanie O'Meara). Jon Spencer explained that many of these detailed maps are more useful as a research tool than as a map for the resource managers. Stephanie O'Meara noted that the maps don't usually get into the kind of detail found on Don Swann's fault map, but these maps should be in the bibliography or GRE report so they will become part of the reference list for the resource manager.

Answering a question concerning soils maps, Phil Pearthree explained that the surficial maps are linked to soils. However, soil maps are separate from the surficial maps and that Pete Biggam (NPS GRD) is producing soils maps for the parks (Sid Covington). Andy Hubbard (NPS Sonoran Desert Network) said they were working with Pete on soils, but their purpose was designed more for ecological monitoring than for simply mapping soils. Phil Pearthree thought that the status of soil and surficial mapping for Saguaro NP was very good.

Where possible, existing AZGS 1:24,000 scale published maps, available in digital format, will be used as the primary digital maps as these possess a structural interpretation and mapping of faults that are more widely accepted for the area. Where this coverage is not available, primarily areas of the Mica Mountain and Tanque Verde Peak quadrangles, and the northern half of the Rincon Peak, the best available maps are the Drewes' maps (GMAPs 1083 and 1084) (Stephanie O'Meara).

GRE mapping action planned for FY 2006 or FY 2007 includes the following:

- The GRE will evaluate a scoping proposal to map in greater detail the surficial deposits in the northwest area of the Tanque Verde Peak quadrangle. The likely agency to conduct the mapping is the AZGS.

- The GRE will convert existing GRE digital data for the Tucson Mountain Caldera map (GMAP 1003) from the GRE coverage/shapefile data model format to the GRE geodatabase data model format.

- The GRE will convert existing GRE digital data for the Rincon Valley quadrangle (GMAP 1083) and Happy Valley quadrangle (GMAP 1084) maps from the GRE coverage/shapefile data model format to the GRE geodatabase data model format. This is required as integration of newly acquired digital data will need to be in the same GIS format for edge-matching and compilation, and because the geodatabase format is now the standard GRE supported deliverable format.

- The GRE will acquire from the AZGS the following digital sources: DGM-8, DGM-10, DGM-12, DGM-44 and DI-17. The GRE will evaluate and convert the digital sources to the GRE geodatabase data model format. Ancillary text and figures associated with the data sources will be formatted and incorporated with existing GRE SAGU project text and figures.

- The GRE will acquire form the AZGS paper source CM-98-B. The GRE will then evaluate and digitize to the GRE geodatabase data model format. Ancillary text and figures associated with the data source will be formatted and incorporated with existing GRE SAGU project text and figures.

Geologic Resource Management Issues

The scoping session for Saguaro National Park provided the opportunity to develop a list of geologic issues, geologic features, and geologic processes, which will be further explained in the final GRE report. During the meeting, Meg Weesner and Don Swann prioritized the most significant issues as follows:

1. Water issues and abandoned mines
2. Establishing an interpretive trail to the Catalina Fault
3. Additional mapping in the Rincon Mountain District

Abandoned mines and surface water issues are briefly discussed in the following text. Permission to establish an interpretive trail to the Catalina Fault has not been granted, although a four-car parking area will be constructed in anticipation of permission to build a trail in the future (Meg Weesner). Additional mapping in the Rincon Mountain District was discussed in the Geologic Mapping section.

Water Issues

One issue discussed was how bedrock effects surface water and groundwater. The park obtains its water from the city of Tucson although the park still has a well in SAGU West in the southwest corner of the park. The well is over 500 feet (150 m) deep and while water quality is good, water quantity may become an issue with water rights in the Rincon Creek area south of the park.

There is no known recharge zone in the park (Meg Weesner). Runoff and recharge rates are not well understood (Jon Spencer). Andy Hubbard noted that two water companies are now working in Rincon Valley and reporting water data to the state. No defined aquifers exist in the Tucson basin. The basin is deep and filled with gravel. Fractured reservoirs also exist in the area, and the Arizona

State Parks has a project to help define the area's hydrogeology (Bob Casavant). The Tucson recharge ponds, however, may be helping the water level in the park's well.

A loss of surface water quantity in the park is due to withdrawal from outside of the park (Don Swann). Drawdown is an issue in the area and the park is working on the problem.

Groundwater recharge in the Colossal Cave area, south of SAGU East, is through sinkholes (Bob Casavant). Colossal Cave does not extend to the park and caves and karst are not an issue in the park (Meg Weesner). Resource inventory maps from the 1950s identify a "cave", but it has not been located. One "cave" in the park is actually a nesting area and more of a breakdown feature, not a karst feature (Don Swann). In answer to Ron Kerbo's question, Meg Weesner thought that the cave might be classified as a talus cave, but the "cave" has no total darkness. Talus caves are part of the cave federal protection act (Ron Kerbo). The NPS is obliged to list every cave as "significant". Meg Weesner didn't know if this crevice would meet the definition of a "cave".

With regards to water quality, all drain fields associated with the Saguaro septic system have been replaced within the last 15 years.

Mining Issues
The park's database of old mines includes 146 shafts and adits in the Tucson Mountain District (Don Swann). These have been mapped, photographed, and measured and the park hopes to develop a mine management plan in the next twenty years. The mines considered "dangerous" have been marked. The big mine in the Rincon Mountain District has been back filled.

The Wild Horse mine on the east side of SAGU West has gates (Meg Weesner). Only three mines were productive and most are just holes in the ground. One 20-foot shaft has a cover over it while some have fences around them. The Gould mine next to a trail has a grate over the shaft. The Mile Wide mine is not on a trail but is not easily accessible. It has a deep shaft and is fenced. A fence also surrounds the Yuma Mine in the Tucson Mountain District (SE1/4, Section 9, T13S, R12E). Heavy metals as well as gold are found in Yuma mine tailings, which have been used by a nearby resident for road gravel on his access road. His road had literally been paved with gold. The Yuma mine is known for its world-class mineral specimens (Sid Covington). In 2005, a Preliminary Assessment/Site Inspection Report was prepared for the Yuma Mine (Baker Jr. 2005). The park is not aware of any further studies of hazardous waste/materials.

Other Issues
Tinajas: Table-size tinajas (ephemeral pools) in SAGU East are important water sources for wildlife and most have been inventoried (Don Swann). They are not significant in SAGU West. Some of the tinajas are in bedrock and some are in unconsolidated material. After a fire, the tinajas may fill up with sediment and may remain filled for some time (Don Swann). One tinaja, for example, has remained filled since 1999. Wildlife depend on tinajas, but once filled with sediment, the tinajas become unavailable. Tinajas may be considered wetlands depending on the definition of a wetland. Otherwise, the park has no wetlands (Meg Weesner).

Flooding and Debris Flows: Last summer several thunderstorms washed out some roads and deposited debris in SAGU West (Meg Weesner). Dirt roads in the park get impacted by debris flows every few summers although paved roads are not often impacted. According to Phil Pearthree, debris flows in the Tucson Mountains are not large. They are close to the mountain roads, however, and may be relevant to park engineers.

Headcut Migration: Headcut migration due to past road construction is an issue in the park (Meg Weesner). These roads have been abandoned since the park expanded and the park would like to convert them to trails. According to Meg Weesner, culverts associated with the roads are responsible for the headcuts. GRD has studied the issue but a report is pending. Andy Hubbard noted that the headcuts may cause hiking problems, also.

Fires: Erosion processes are related to fire history. After a fire, sediment washed downslope increases due to unchecked erosion. The use of herbicides has helped reduce fires spread by exotic vegetation and has allowed the roots of plants to continue to stabilize the soil.

Archaeology: Lee Allison (AZGS) suggested that mapping Quaternary deposits was a way to recognize potential archaeology sites. Vance Holliday of the University of Arizona currently has a project that identifies sites based on Quaternary mapping. The park has surveyed 450 archaeological sites in SAGU East, and these are concentrated along roadways (Meg Weesner). Scattered sites have been recognized in SAGU West.

Non-issues: Geologic issues that are relevant to other NPS units but not to Saguaro National Park include cryptobiotic soils, fossils, caves and karst, geothermal issues, and active faulting. Cryptobiotic soils are not monitored in the park, but livestock grazing is no longer allowed in SAGU West and hiking off trail also is not allowed. Soils, in general, are covered with the park's soil monitoring program. Although a dinosaur bone was found near Gates Pass in a block of rock encased in volcanic tuff and dinosaur bones may occasionally be found in Cretaceous sandstone and conglomerate, fossils also are not a primary management issue. Fossils should be present in the SAGU West, but the limestones associated with fault zones are too brecciated and altered to have any preserved fossils. Park personnel have never met anybody in the park collecting fossils or anyone who had a fossil-like rock.

Two final issues were briefly discussed. First, with regard to geomorphology, ongoing channel geomorphology is being studied and is well inventoried (Andy Hubbard). Second, the permit for power lines in SAGU West has expired. The park does not plan to re-permit the lines. The power company would like a renewed permit as well as permission to rebuild on parkland.

Features and Processes

Rincon Mountain District: In the Rincon Mountain District, the Catalina Fault, a normal fault that dips about 20 degrees to the southeast, separates the mylonite gneiss of the metamorphic core complex from the overlying Paleozoic strata (Jon Spencer). The Santa Catalina Mountains have been displaced by the Catalina Fault and, if restored to their original position, would rest beneath the Tucson Mountains.

In his presentation and on an afternoon field trip, Jon Spencer emphasized how significant was the exposure of the Catalina Fault in the park. It is one of only three sites where this detachment fault is exposed. The other two sites are unavailable because they are on private land or soon-to-be-developed private acreage. Both Jon Spencer and Bob Casavant noted visitor interest in the geology of Saguaro NP, once they know more about it, and how geologists from other countries come to Saguaro just to see the Catalina Fault. Jon Spencer would like to see a trail and interpretive signs constructed to the site. There has been an undercurrent of interest to making a trail to the fault, and the park will develop a four-car parking area along the road so they will be prepared if they ever get permission for a trail (Meg Weesner). With limited discretionary funds, the park is just trying to maintain what they have today. Ron Kerbo (NPS GRD) suggested that this type of information needs to be forwarded to the Education and Outreach Branch of GRD for their help and support.

Overlying the metamorphic rocks is the Paleozoic Bisbee Group. The Bisbee Group contains strata that has been turned upside down from its original depositional sequence. The strata represent an excellent example of inverted stratigraphy. Caves in the Rincon Mountains (such as Colossal Cave) are located in the deformed Paleozoic limestones that lie above the fault.

Features represented in the Rincon Mountain District include:

- Features related to the metamorphic core complex such as the Catalina Fault and mylonite gneiss
- Inverted Paleozoic stratigraphy
- Foliations, faults, and augen gneiss along Cactus Loop Drive

Tucson Mountain District: SAGU West, about 20 miles (13 km) west of SAGU East, is typical of the Basin-and-Range Province and consists of a normal-faulted, east-tilted wedge of Paleozoic and Mesozoic sedimentary strata. The range is about 20 miles (13 km) long and 7 miles (4 km) wide. Features and processes in the Tucson Mountain District include:

- Basin-and-Range style normal faults
- Volcanic processes and deposits that represent caldera formation and collapse in which house-size blocks of Precambrian schist, Paleozoic and Mesozoic sedimentary rocks, and Tertiary volcanic rocks are juxtaposed in a matrix of sandstone and tuff (Jon Spencer).
- Erosion and debris flow processes and deposits

Recommendations

- Establish an interpretive trail to the Catalina Fault outcrop
- Map the area west and south of the Catalina Fault
- Remap the Loop Drive
- Map Quaternary deposits as a way to recognize archaeology sites

Action Items

No action items were discussed at the meeting.

References

Baker, Jr., Michael. 2005. Preliminary Assessment/Site Inspection Report: Old Yuma Mine, Saguaro National Park, Tucson, Arizona. Prepared for the NPS Intermountain Support Office, Denver, Colorado, 34 p

Davis, George H. 1987. Saguaro National Monument, Arizona: Outstanding display of structural characteristics of metamorphic core complexes. Geological Society of America Centennial field guide, Cordilleran Section, v. 1, 35-40

Table 2. Scoping Meeting Participants

Name	Affiliation	Position	Phone	E-Mail
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